In-Use Off-road Diesel Vehicle Proposed Regulation

May 25, 2007

California Environmental Protection Agency

Air Resources Board

Outline

- Need for Emissions Reductions
- Affected Industries
- Proposed Regulation
- Benefits and Impacts
- Technological Feasibility
- Issues
- Changes to original staff proposal
- Recommendation

Need for Emission Reductions

Need for Emission Reductions

- Must reduce Diesel Particulate Matter (PM)
  - 70% of known cancer risk from all air toxics
  - Thousands of deaths per year in California
- Must reduce oxides of nitrogen (NOx)
  - Ozone and secondary PM formation
- Attain ozone and PM standards

California Diesel Risk Reduction Plan

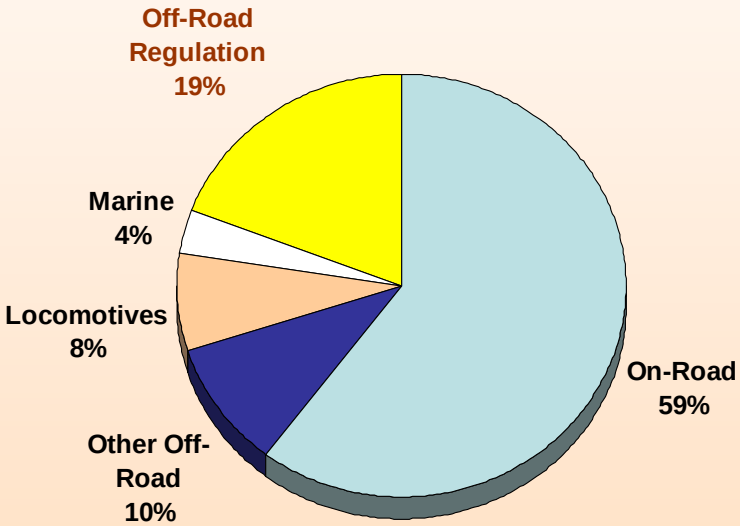
- Adopted in 2000
- Established Goals
  - Reduce diesel PM emissions
  - 75% reduction by 2010
  - 85% reduction by 2020

Significant Health Impacts from Off-Road Diesel Vehicles (2005)

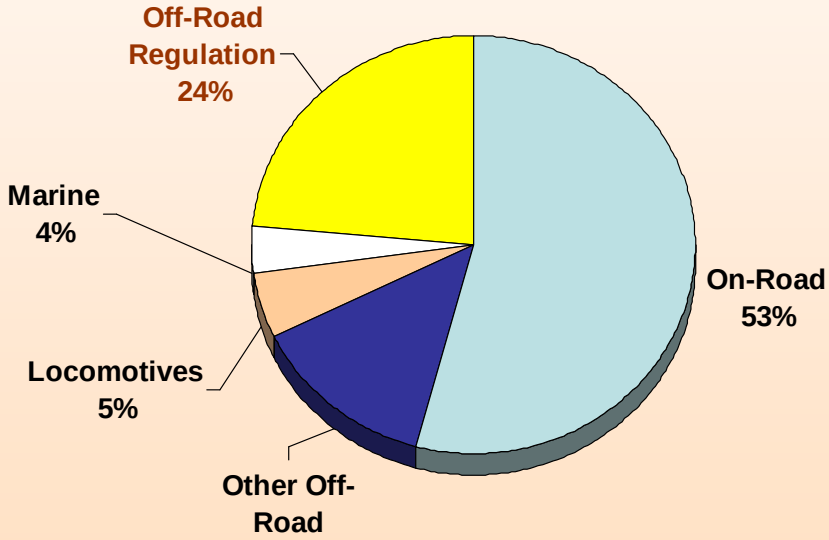
Premature deaths	**1,100**
Cases of asthma and lower respiratory symptoms	**32,000**
Work loss days	**190,000**
Restricted activity days	**1,100,000**

Large Fraction of 2005 Mobile Source Diesel Emissions

NOx

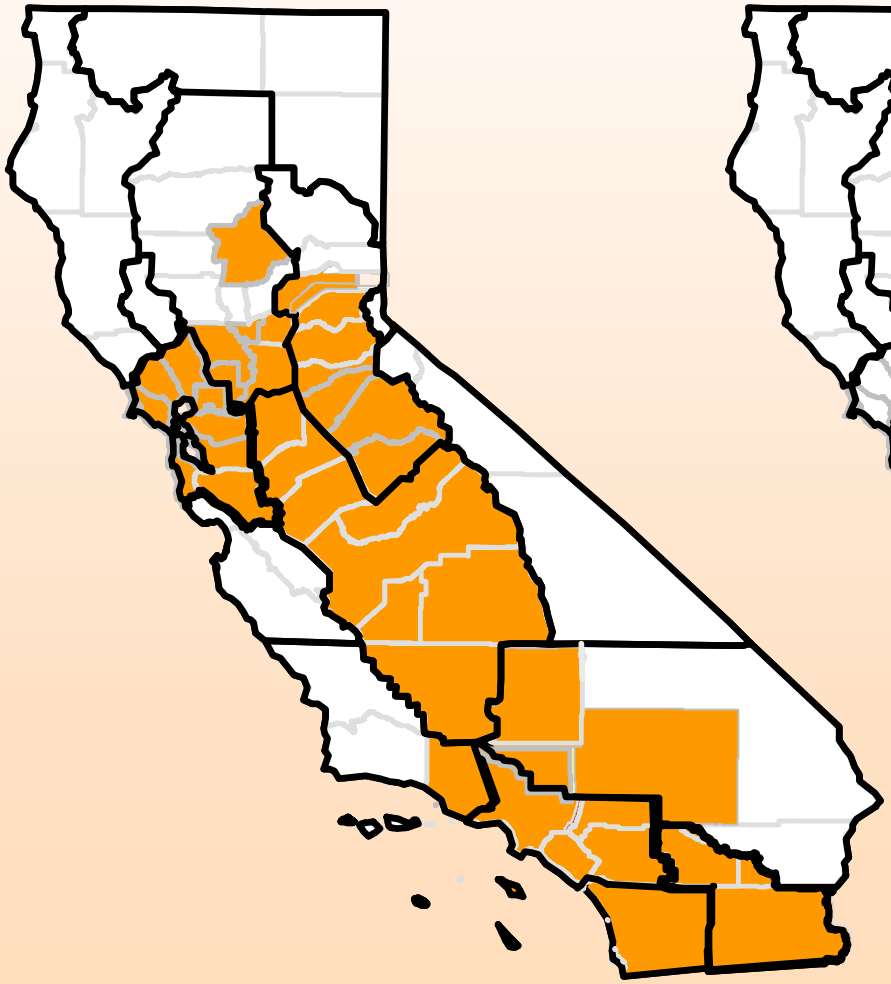


PM

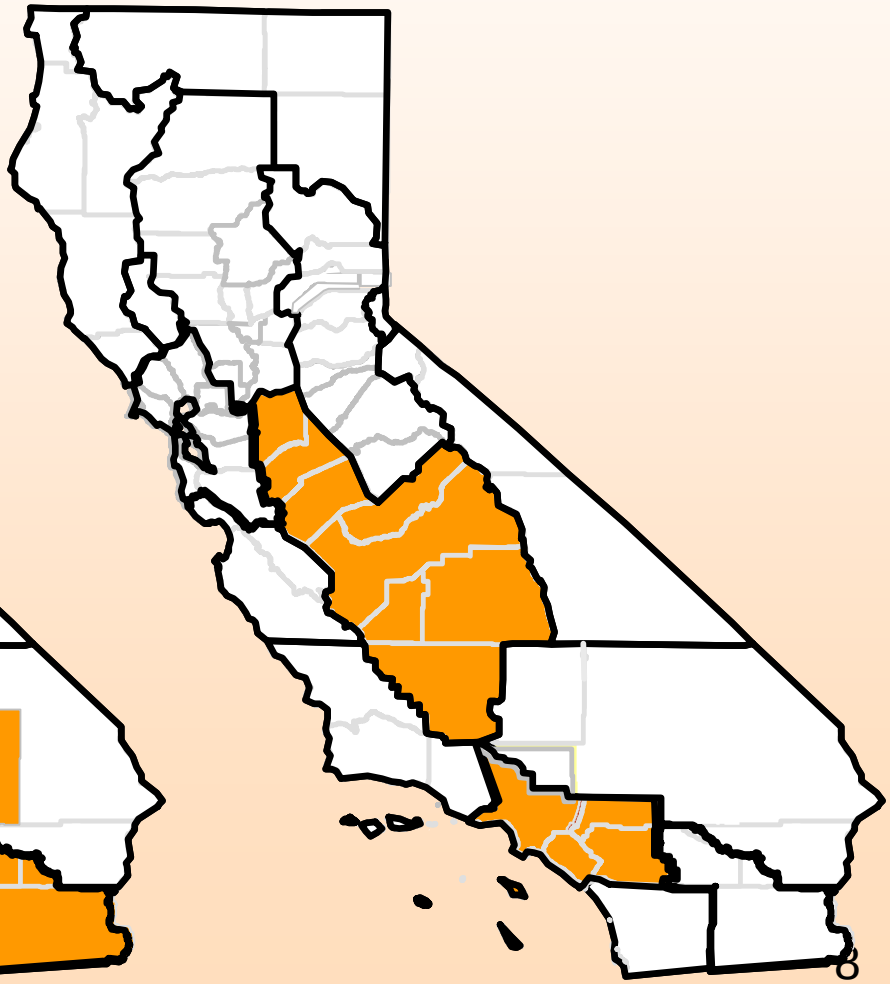


Federal Nonattainment Areas

8-hr Ozone Annual



PM 2.5 Annual



SIP Strategy

- Major component of proposed SIP
- South Coast and San Joaquin Valley
  - 2015 PM2.5 attainment date
  - 2021 South Coast ozone attainment date
- South Coast NOx reduction needs
  - $PM_{2.5}$; 30% reduction in 2014
  - Ozone; more than 50% reduction in 2020
- Direct $PM_{2.5}$ reductions from proposed regulation

Affected Industries and Vehicles

Diverse Vehicle Types Covered

Dozer

Loader

Belt Loader

Aerial Lift

Backhoe Loader

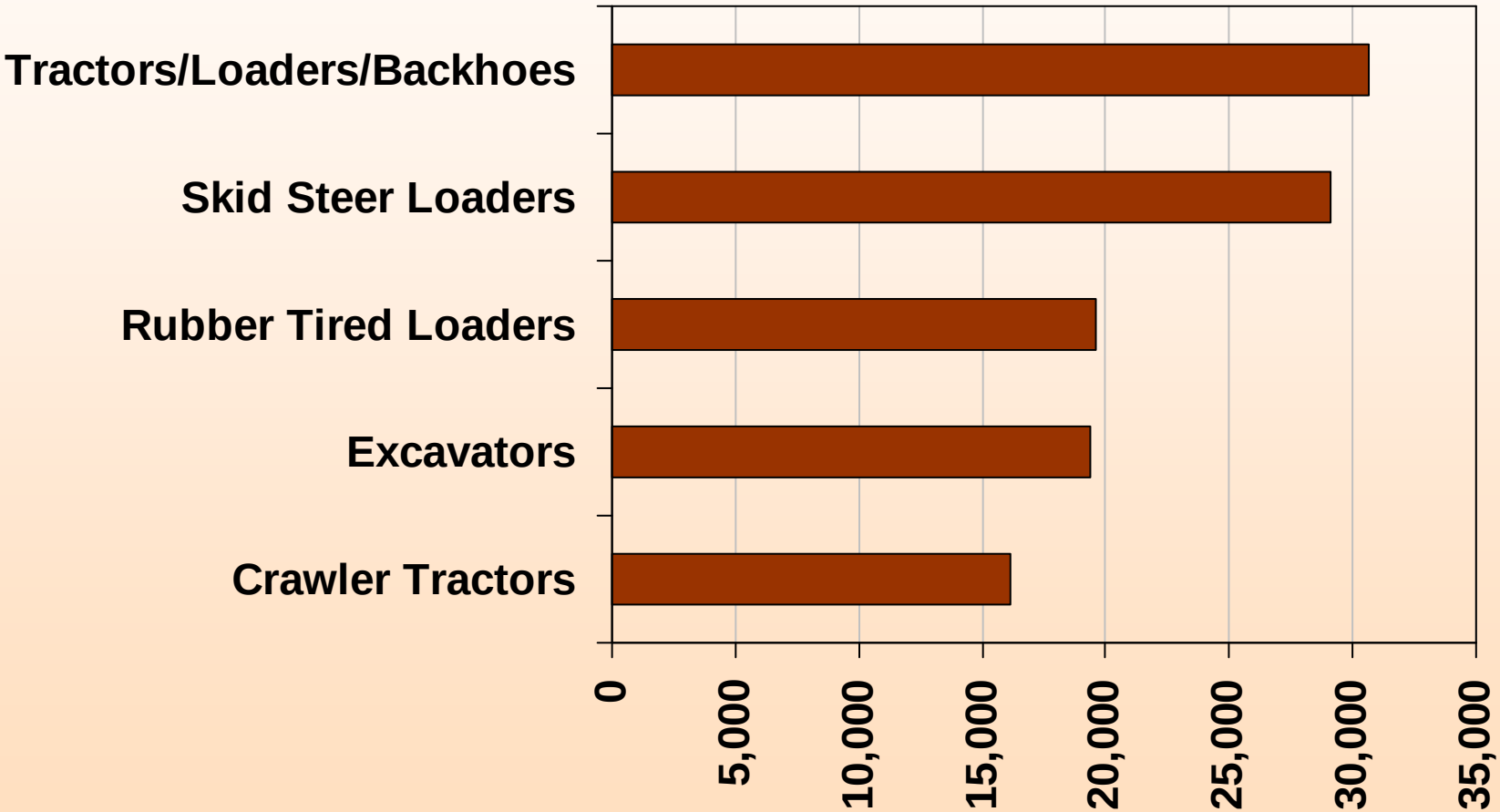
Telescopic Forklift

Ground support equipment

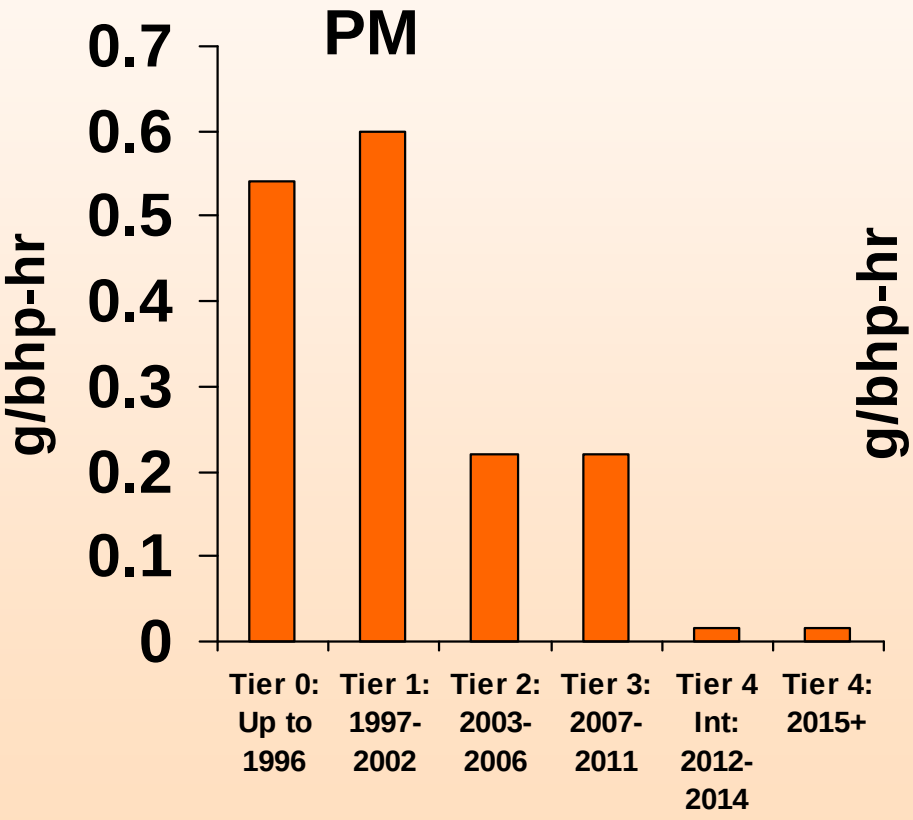
Skid Steer

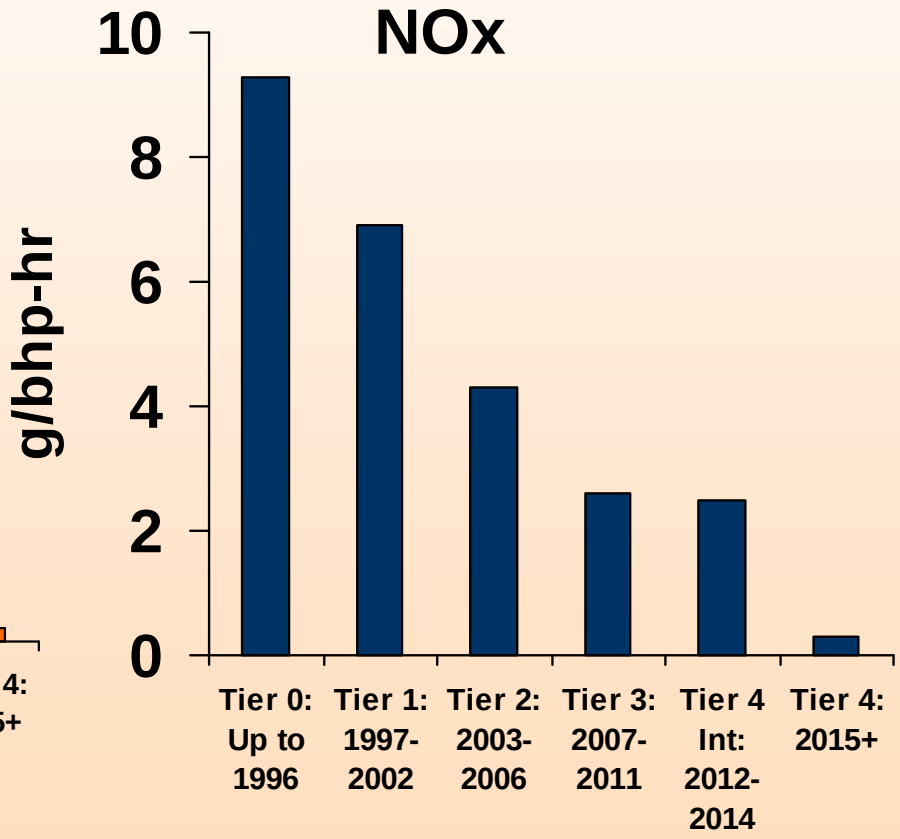
Mast Forklift

180,000 Vehicles Affected (2005 Population)

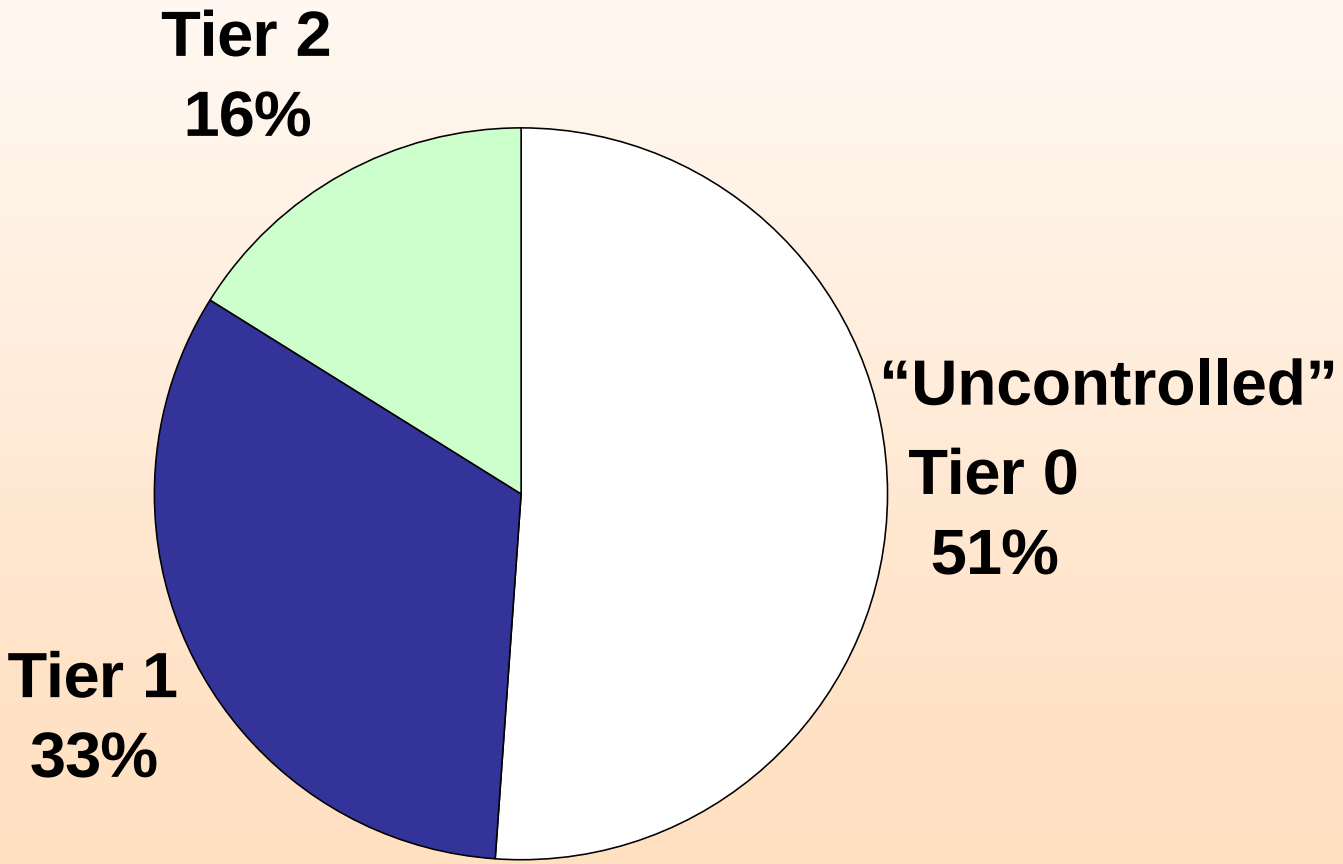


New Engine Standards Make New Engines Cleaner (100-174 hp)

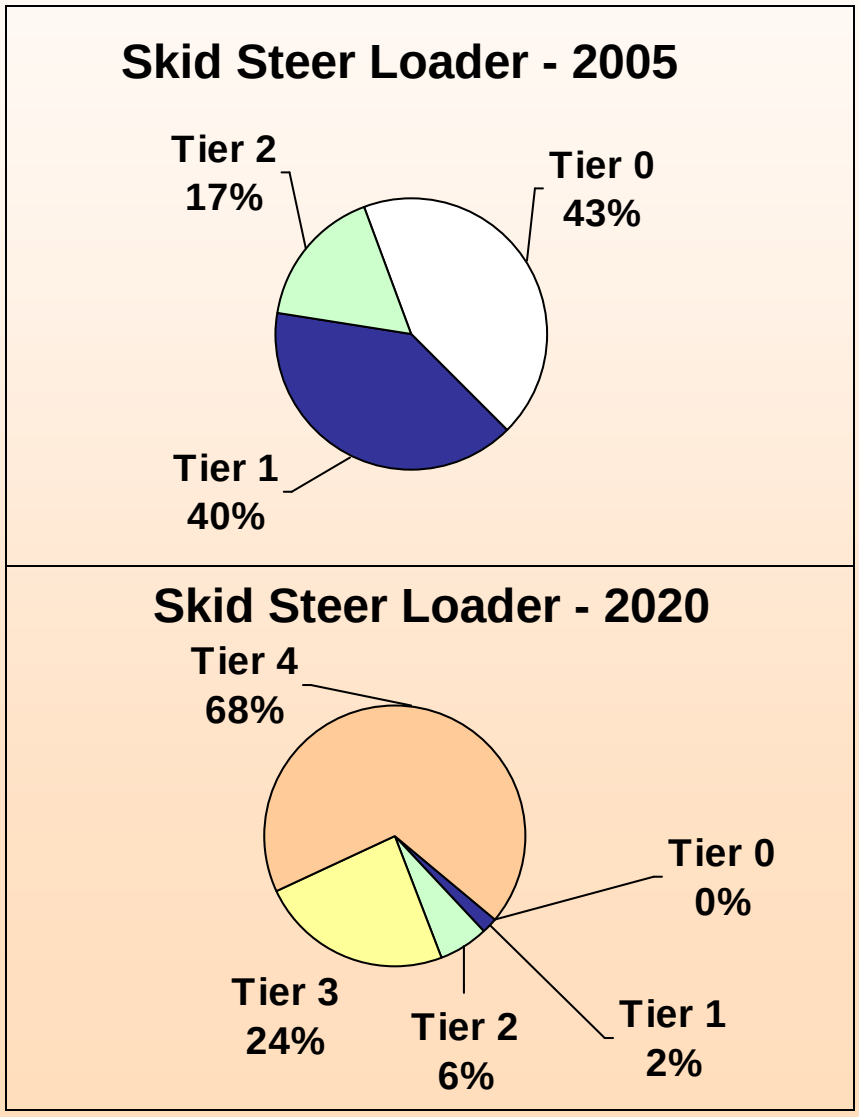




Tier Distribution of Vehicle Population Subject to Regulation (2005)



Tier Distribution Varies By Equipment Type

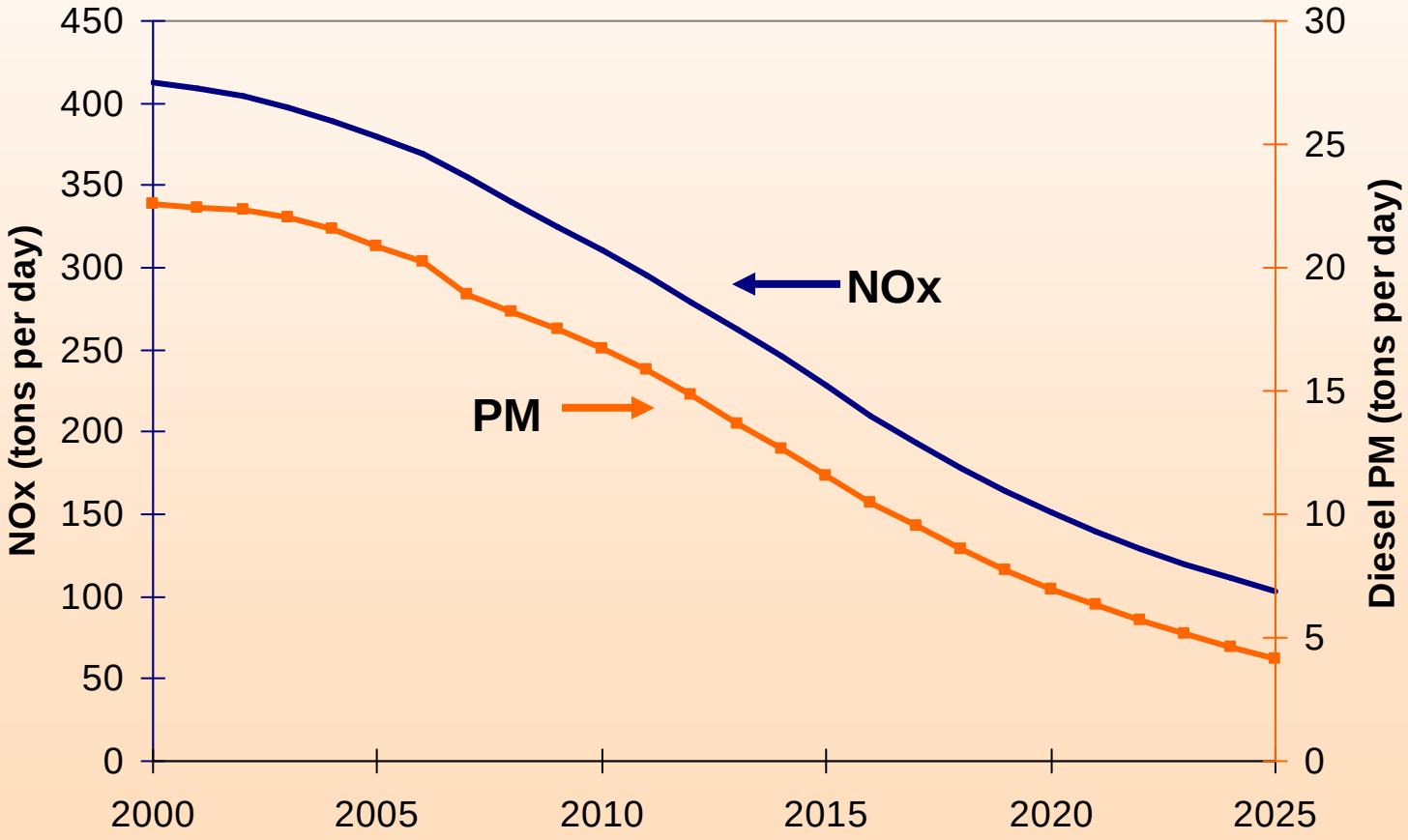


Improved Emission Inventory

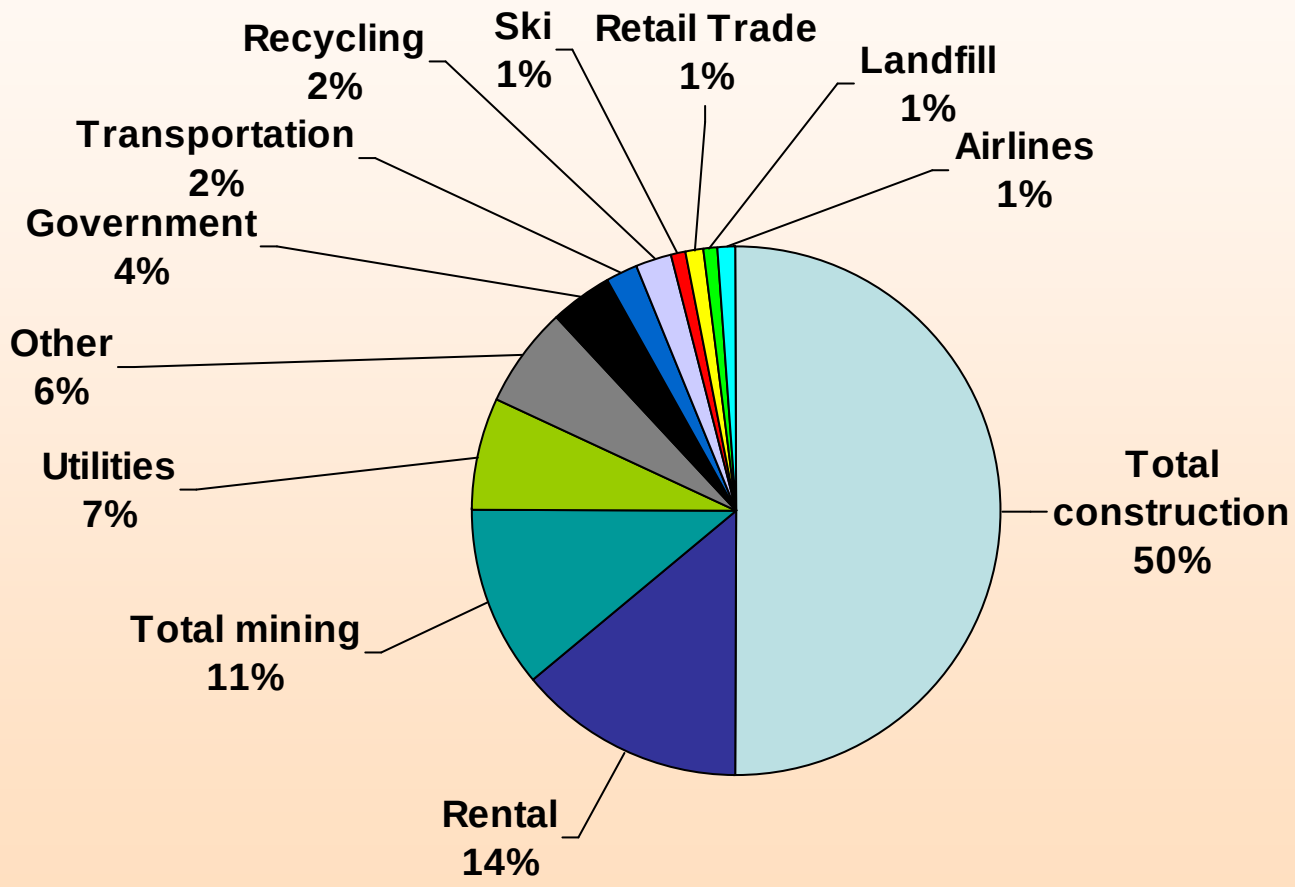
- OFFROAD2007 model updated using:
  - Market research reports
  - Input from stakeholders
  - Validated by surveys and other sources
- Major changes:
  - Longer vehicle useful lives
  - Vehicles are used less as they age
  - Better characterization of California fleet
- Best available estimate for California

Baseline Emissions

- Emissions drop in absence of regulation but not fast enough

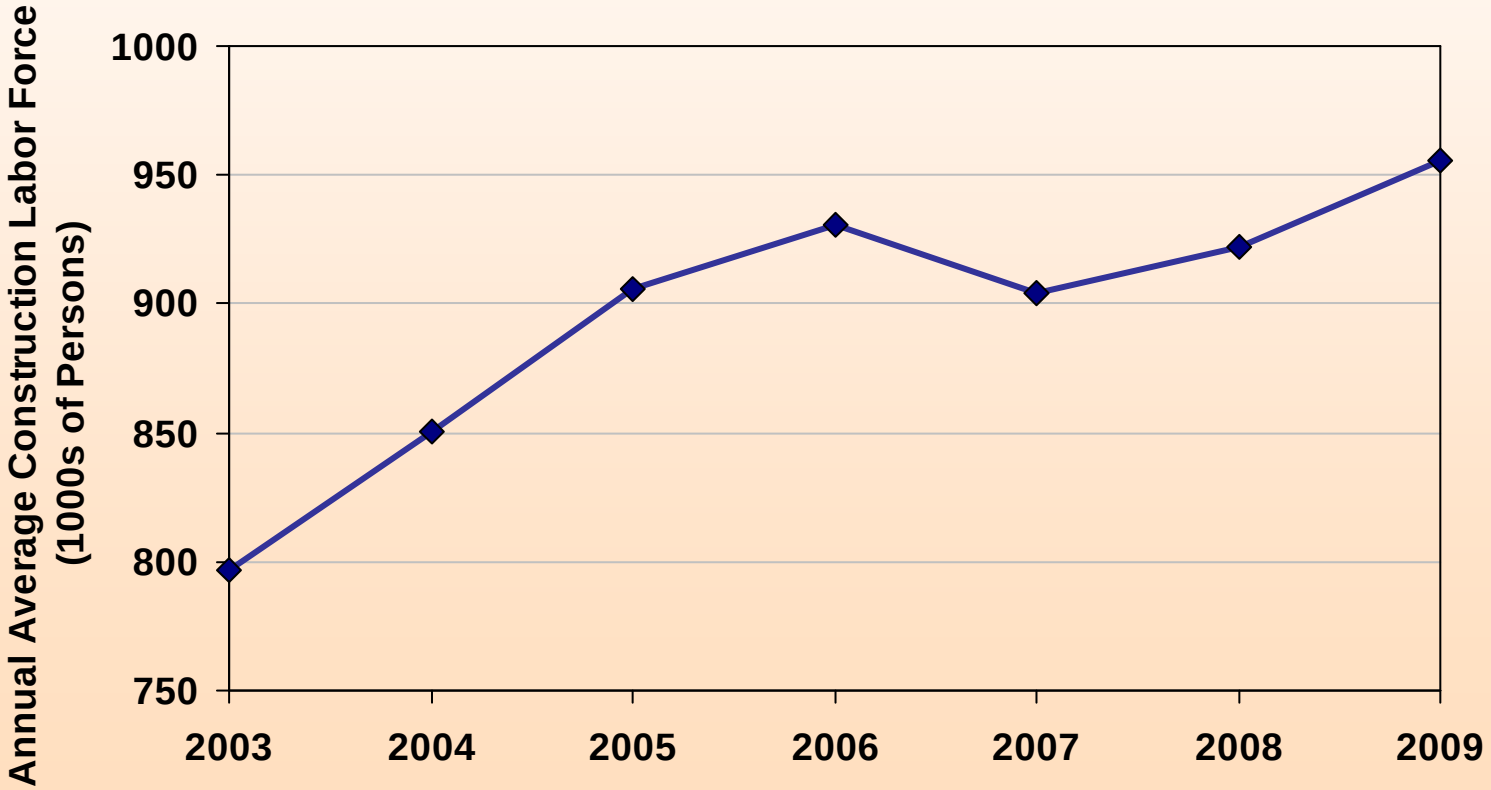


Many Industries Affected
(% vehicles)

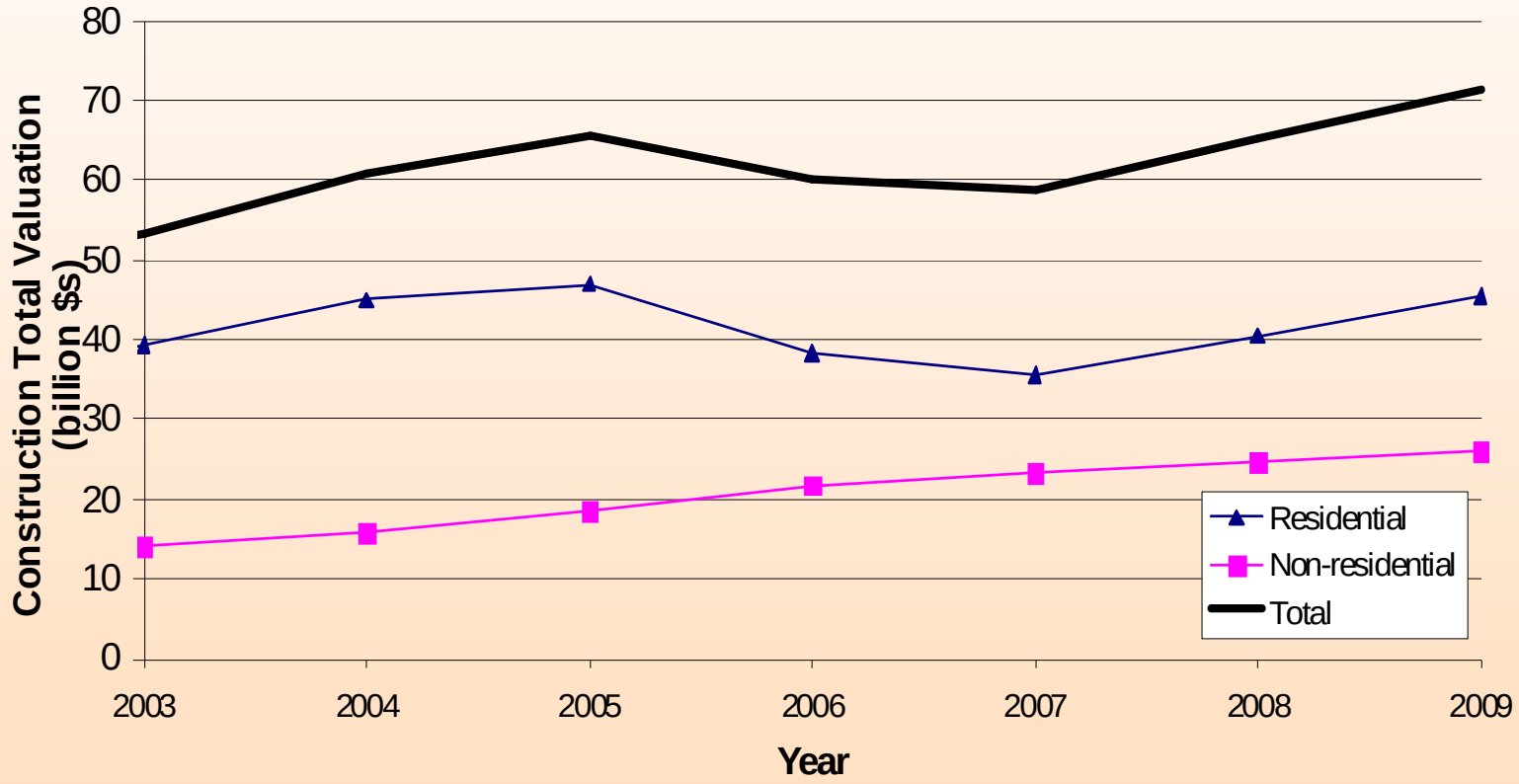


Construction Firm Employment

- 942,000 employed in California
- Growth about 5% per year 2003-2006



California Construction Valuation



Proposed Regulation

Regulation Overview

- Applies to off-road vehicle engines over 25 hp
- Beginning in 2009
  - Labeling and annual reporting
  - Idling limits
  - Limits on adding dirty vehicles to fleets
- Control requirements begin
  - 2010 for large fleets
  - 2013 for medium fleets
  - 2015 for small fleets

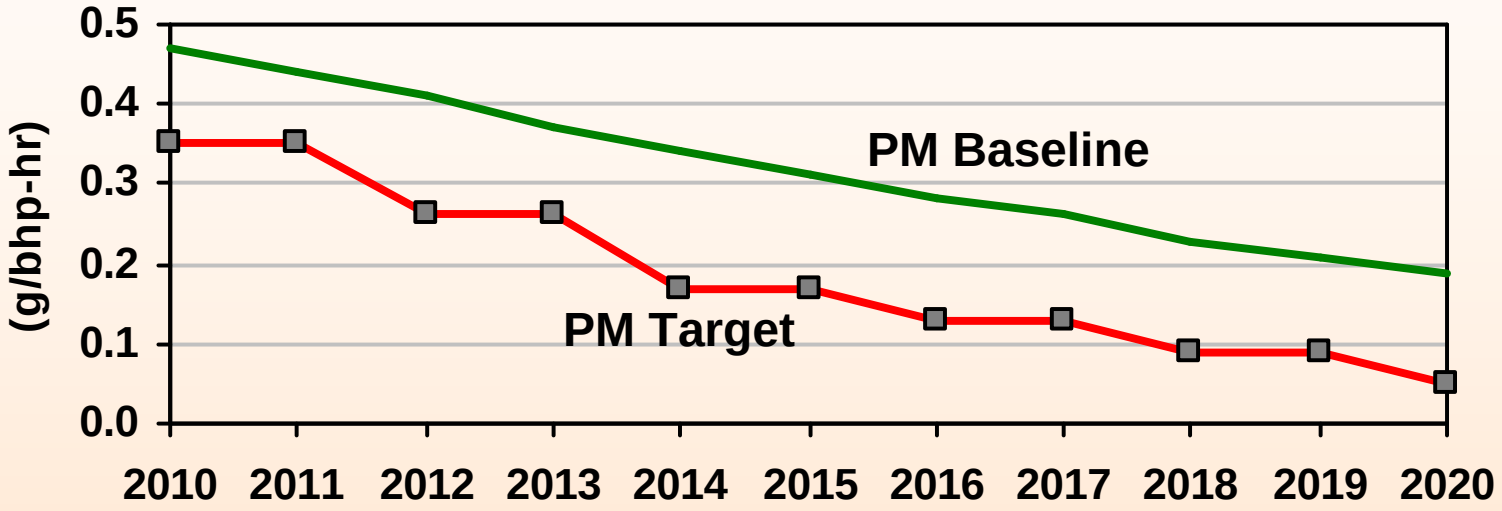
Two Options to Comply

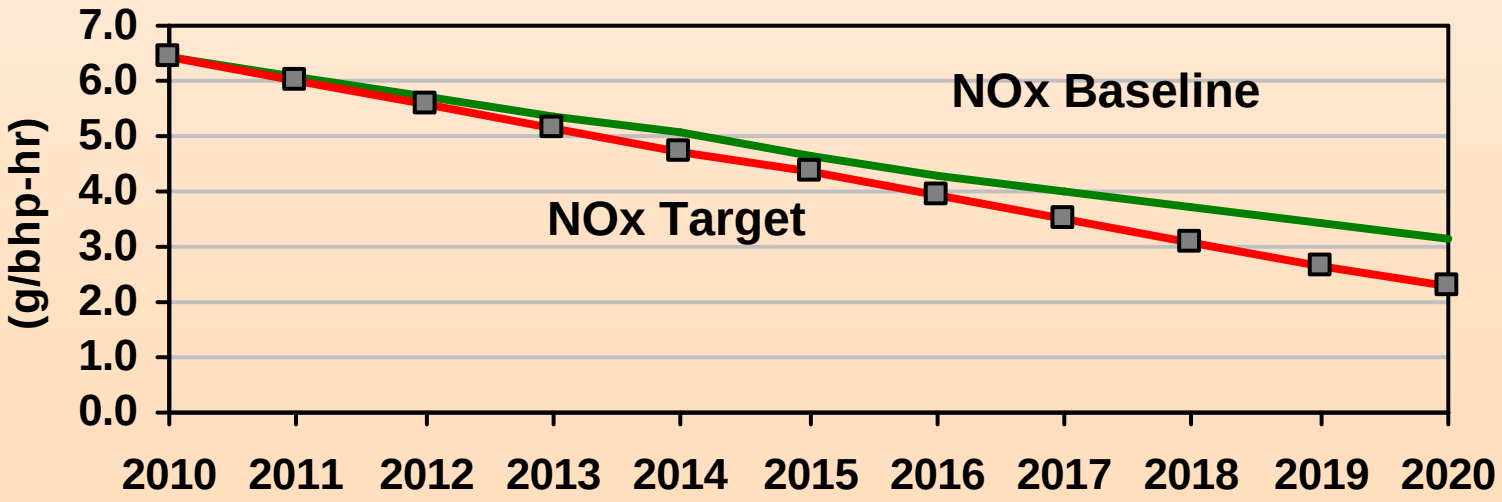
- Meet fleet emission targets by any method

  or

- Demonstrate progress in reducing emissions
  - Called Best Available Control Technology (BACT) requirements
  - “Safety valve” for fleets that cannot meet targets

Fleet Average Emission Targets





Compliance Options

- Install NOx or PM exhaust retrofits
- Buy cleaner new or used vehicles
- Install cleaner engines (repower)
- Retire dirty vehicles

BACT Requirements
"A Safety Valve"

- Fleets never required to do more than BACT requirements
- Apply PM retrofits to meet PM requirements
  - 20% of hp per year
  - No action required if not available
- Turn over engines to meet NOx requirements
  - 8-10% of hp per year
  - Engine turnover reduced with NOx retrofits
- Once fleet averages are met, fleets will do less

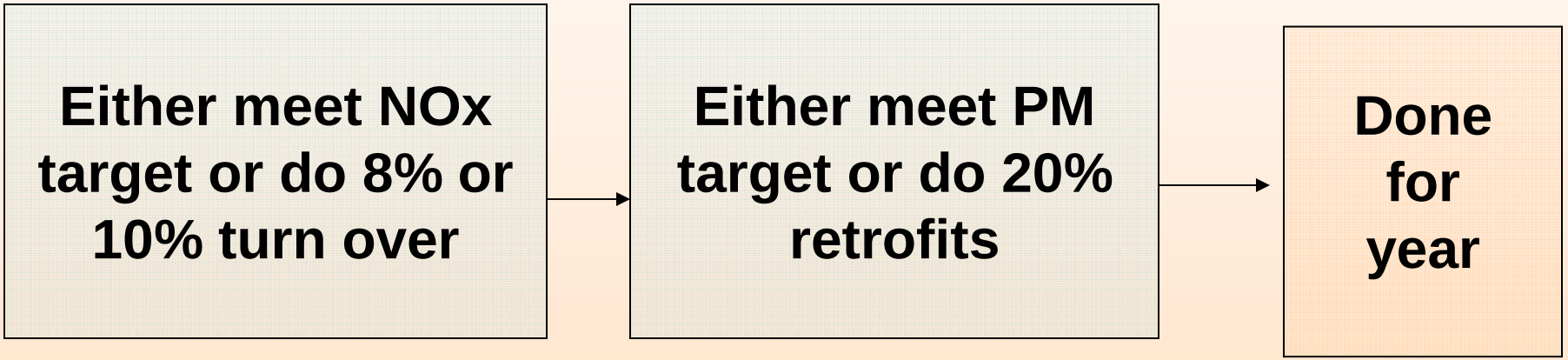
Requirements Vary by Fleet Size

Fleet Size Category	Description	Dates and Requirement
Small	Small business less than 1,500 hp or Municipality less than 1,500 hp or Municipality fleet in low population county	2015-2025 PM only
Medium*	Municipality with 1,501 to 5,000 hp or Business less than 5,000 hp (not “Small”)	2013-2020 PM and NOx
Large*	Fleets with more than 5,000 hp	2010-2020 PM and NOx

* Same requirements for large and medium fleets, only initial compliance date varies.

Annual Compliance Process

Large and Medium Fleets

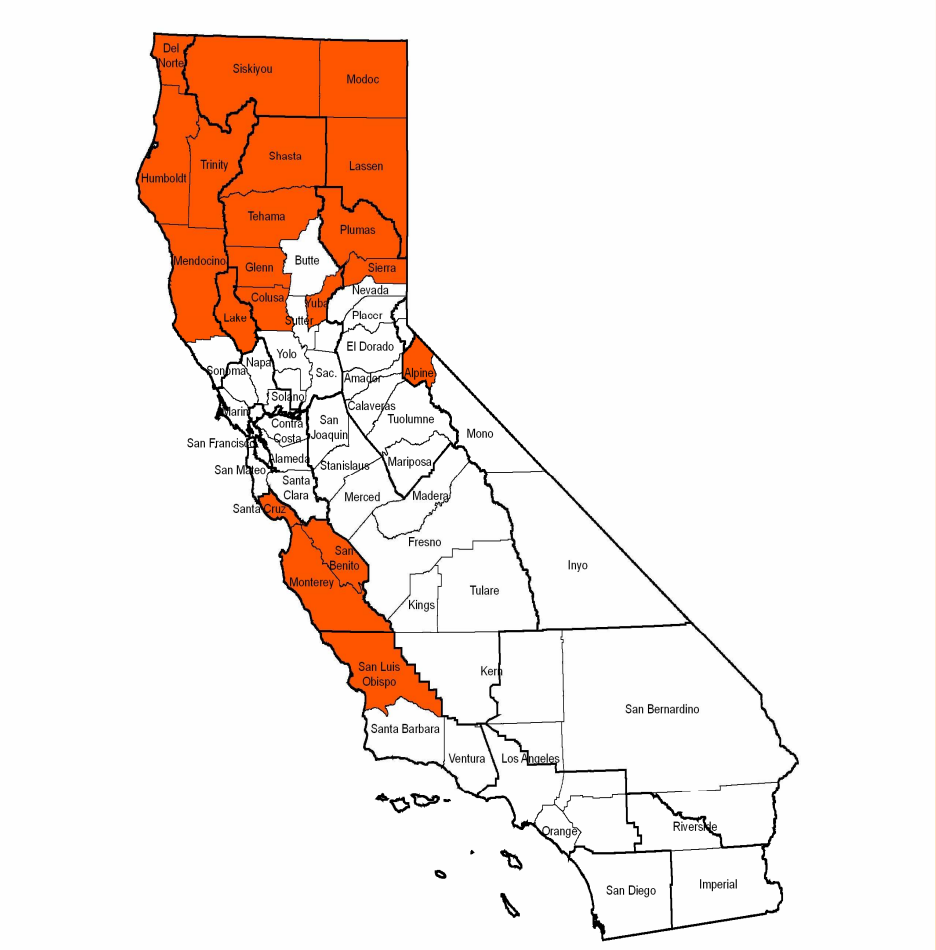


Special Provisions

- Exemptions or compliance extensions
  - Low-use vehicles
  - Vehicles in attainment areas
  - Manufacturer delays
- No retrofit requirements
  - Engines in vehicles less than 5 years old
  - No retrofit available
  - Retrofit not safe
- No turnover requirements
  - Small fleet
  - Used vehicle not available
  - Less than 10 years old
  - Retrofit in past 6 years
  - Certain rural fleets

Special Provisions for Attainment Counties

- Fleets captive to Federal attainment areas
  - Do not need to meet turnover requirements or NOx fleet averages



Regulation Provides Early Credit

- NOx retrofits in lieu of BACT turnover
- Early repowers and turnover
- Electric and alternative fuel vehicles
  - Double credit for turnover to electric vehicles
- Double credit for early PM retrofits

Enforcement

- Annual fleet reporting
- Vehicle labeling
  - Unique vehicle identification number
- Inspection
  - Fleet audits
  - Facility and construction project inspections
  - Roadside inspections
- Additional enforcement staff

Implementation, Outreach, and Education

- Committed to work with industry
- Extensive outreach and education
- Compliance assistance
- Planning tools

John Deere Backhoe with diesel particulate filter under hood

2 ½ Year Regulation Development

November 2004	First workshops
July 2005	First regulatory concepts PM-focused BACT rule
January 2006	Fleet average concept
July 2006	NOx strategies added
November 2006	Draft regulatory language

Regulatory Development
Extensive Outreach

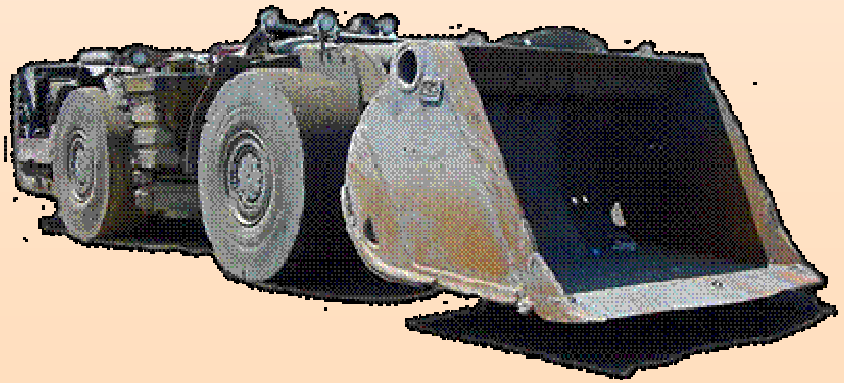
- 13 public workshops
- 6 public workgroup meetings
- Over 45 meetings with stakeholders
  - Including CalTrans, CalOSHA, CIAQC and others
- Over 376,000 mailings
  - Contractors, landfills, recycling facilities, mines, airports, portable equipment owners, etc.

Alternatives Considered

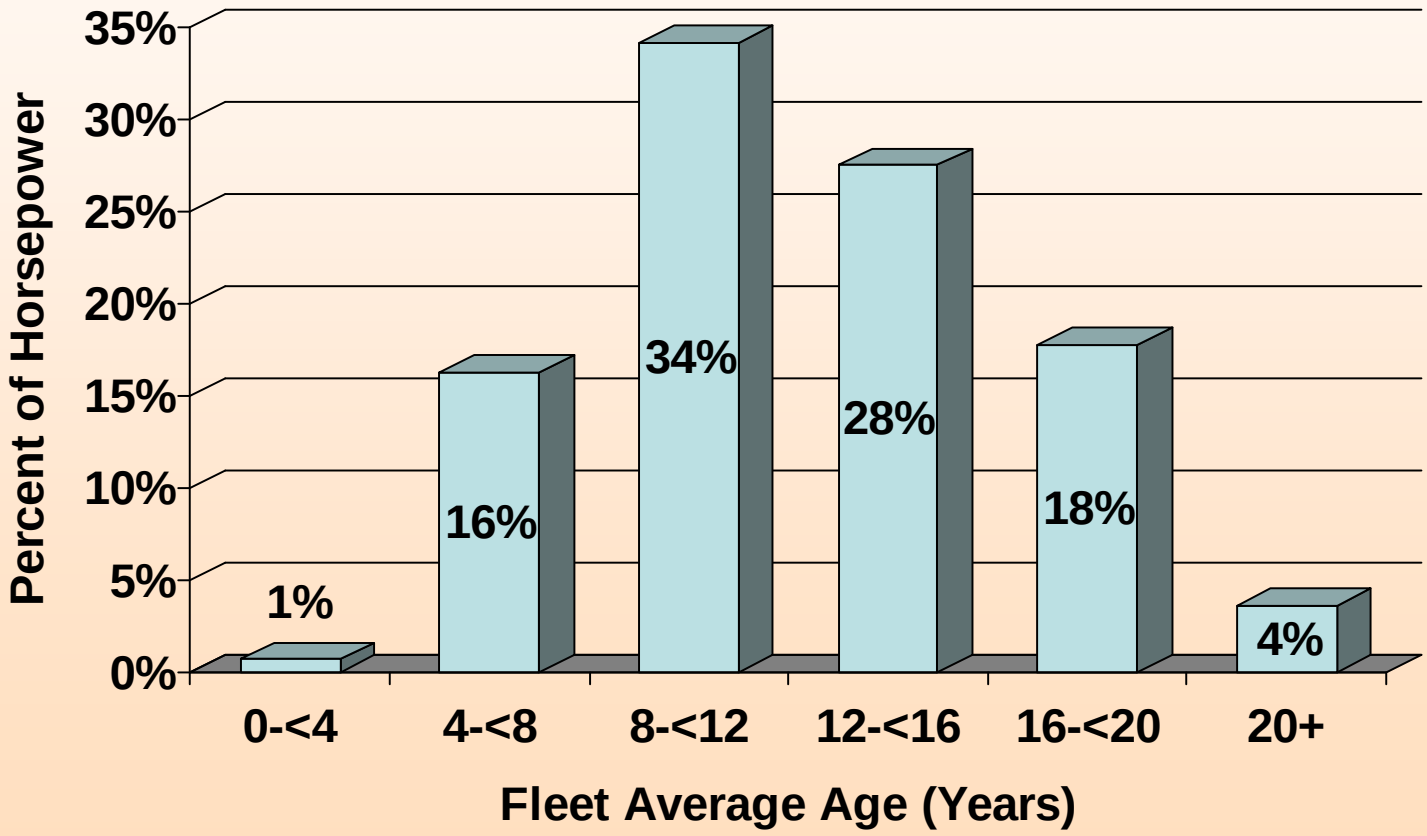
- No action – natural turnover
- PM-only regulation
- Mandatory phase-out of dirtiest engines
- Mandatory NOx and PM retrofits

Stakeholder Suggestions

- Many comments incorporated into staff proposal
  - Fleet average
  - Credit for electric and alternative fuel
  - Delayed initial compliance dates
  - Softer early NOx targets and less early turnover
  - Credit for early action



Fleet Age Distribution

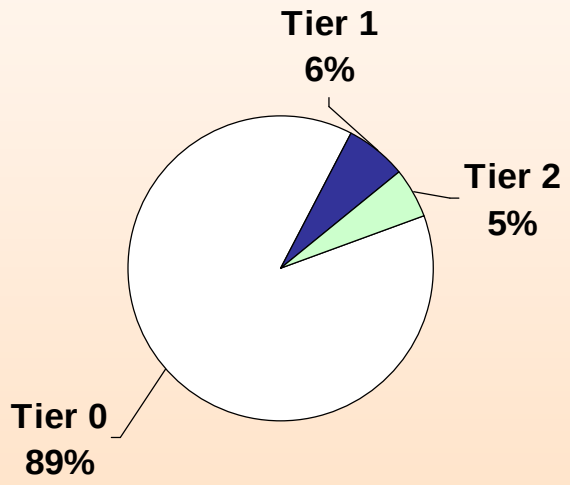


What Regulation Means for Fleets

- Half of fleets will meet 2010 NOx targets with normal turnover
  - Oldest and dirtiest fleets do more (safety valve)
  - Newer fleets do less
- Most fleets would do maximum 20% PM retrofits in first 2-3 years
  - Few retrofits after 3 years
- Only a small impact on most rental fleets
  - May bring new business

Compliance Example
Fleet 1 - Older Earth Moving Fleet

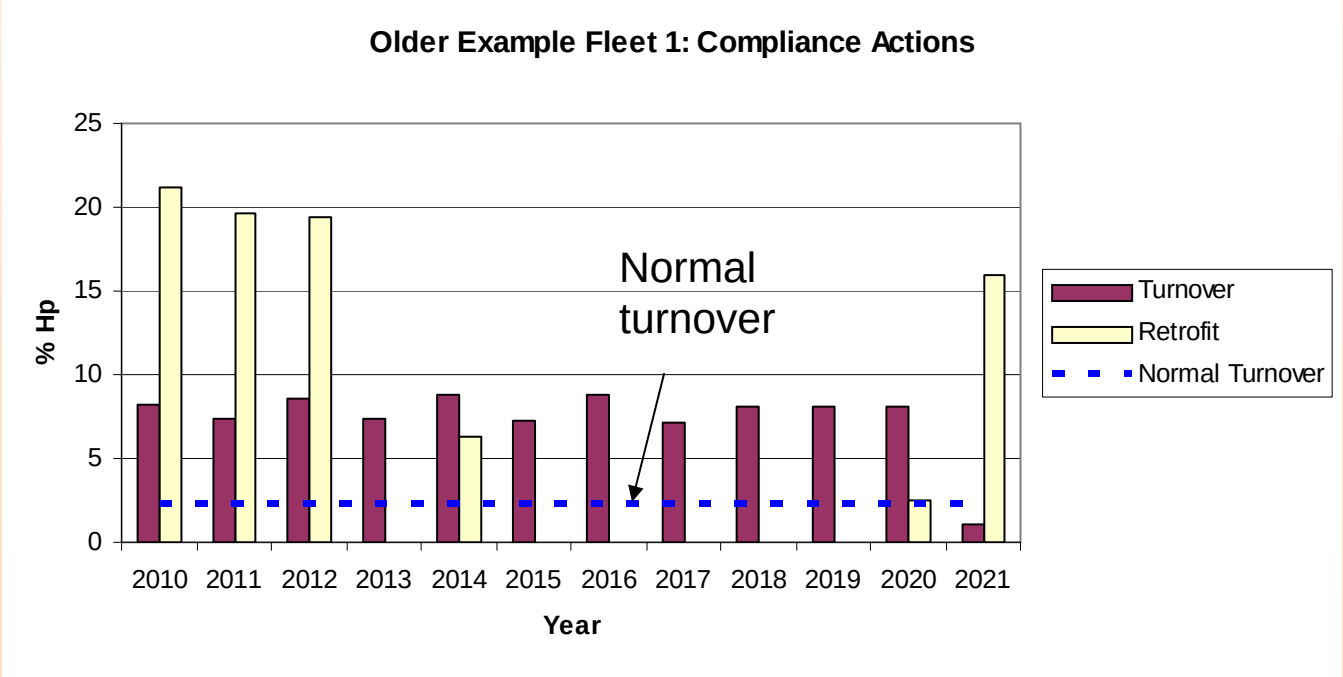
- Represents 4% of all fleets
- Fleet in 2008
  - 88 engines totaling 40,000 hp
  - Scrapers, tractors, and dozers
  - Average age of vehicles 21 yrs
  - Normal turnover 2% per year
  - Normally buys used
- “Worst-case” fleet



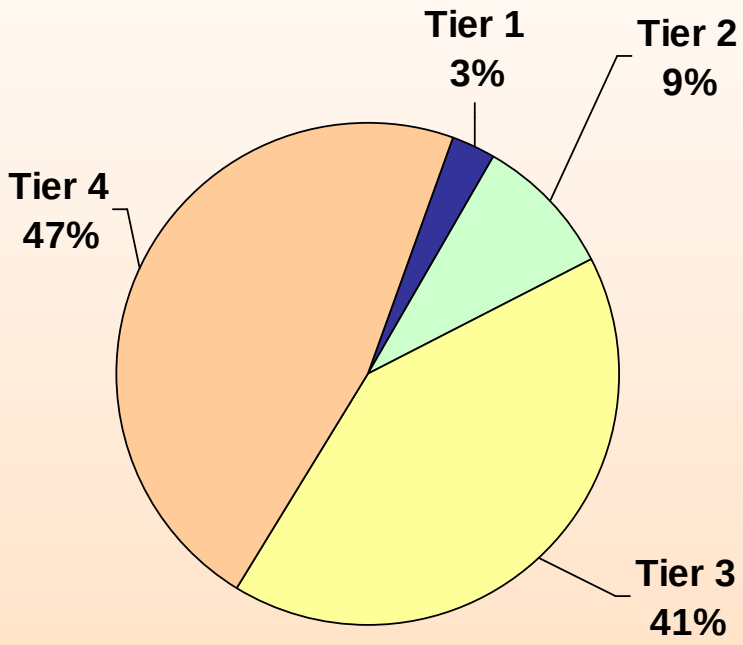
Tier Distribution in 2008

Fleet 1 Compliance Actions

- Continues to buy used vehicles
- 8% turnover per year (safety valve)
- 20% retrofits in first 3 years; few thereafter



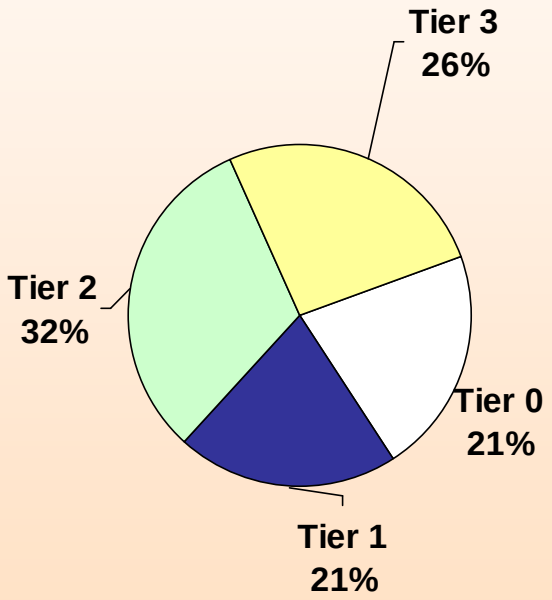
Fleet 1
Engine Tier Distribution in 2020



- Majority of engines needed to comply with 2020 goals already available today

Compliance Example
Fleet 2 - General Contractor Fleet

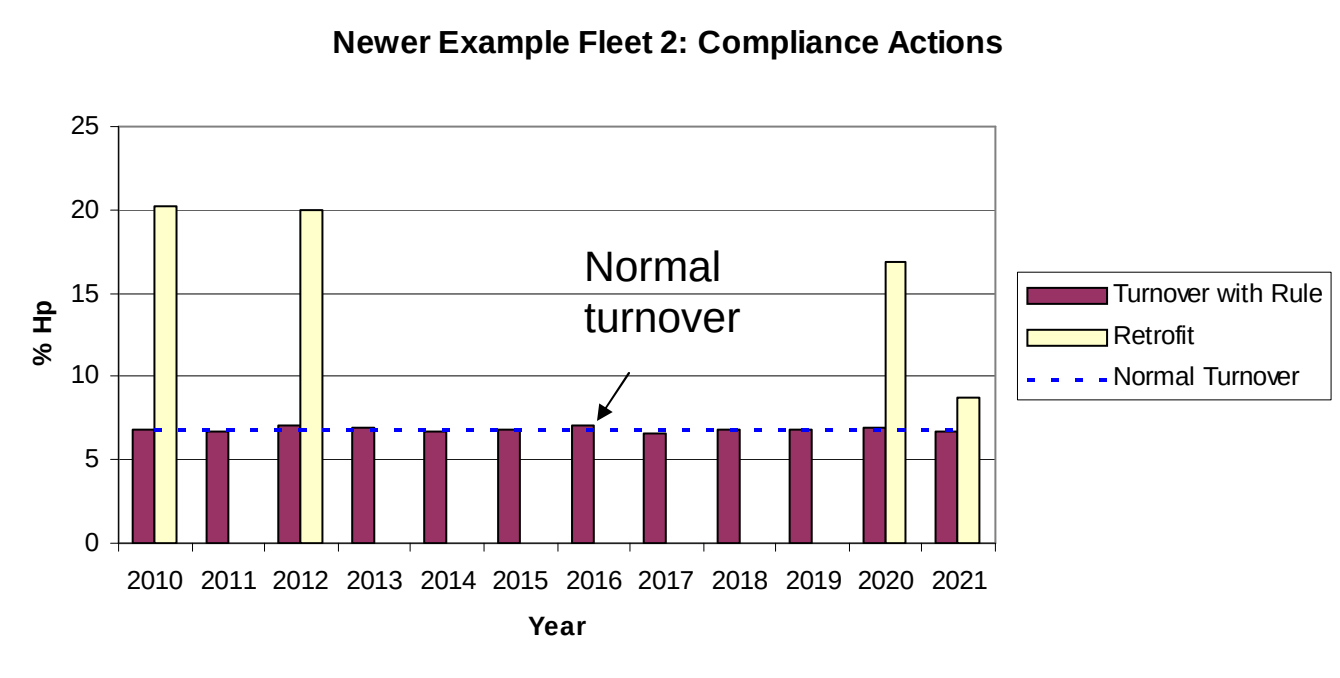
- Represents 16% of fleets
- Fleet in 2008
  - 758 engines totaling 182,000 hp
  - Wide variety of vehicle types
  - Average engine size 240 hp
  - Average age 7 yrs
  - Normal turnover to new vehicles at 7% per year



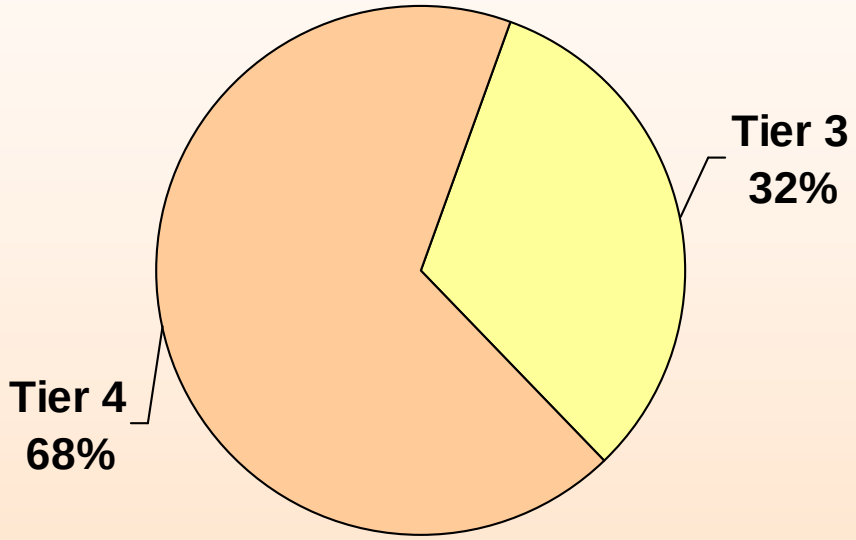
Tier Distribution in 2008

Fleet 2
Compliance Actions

- Meets NOx targets in all years with normal turnover
- Meets PM targets in all but two years
- 20% PM retrofits in 2010 and 2012 (rest in 2020)



Example Fleet 2
Engine Tier Distribution in 2020



- Same Tier distribution as without regulation

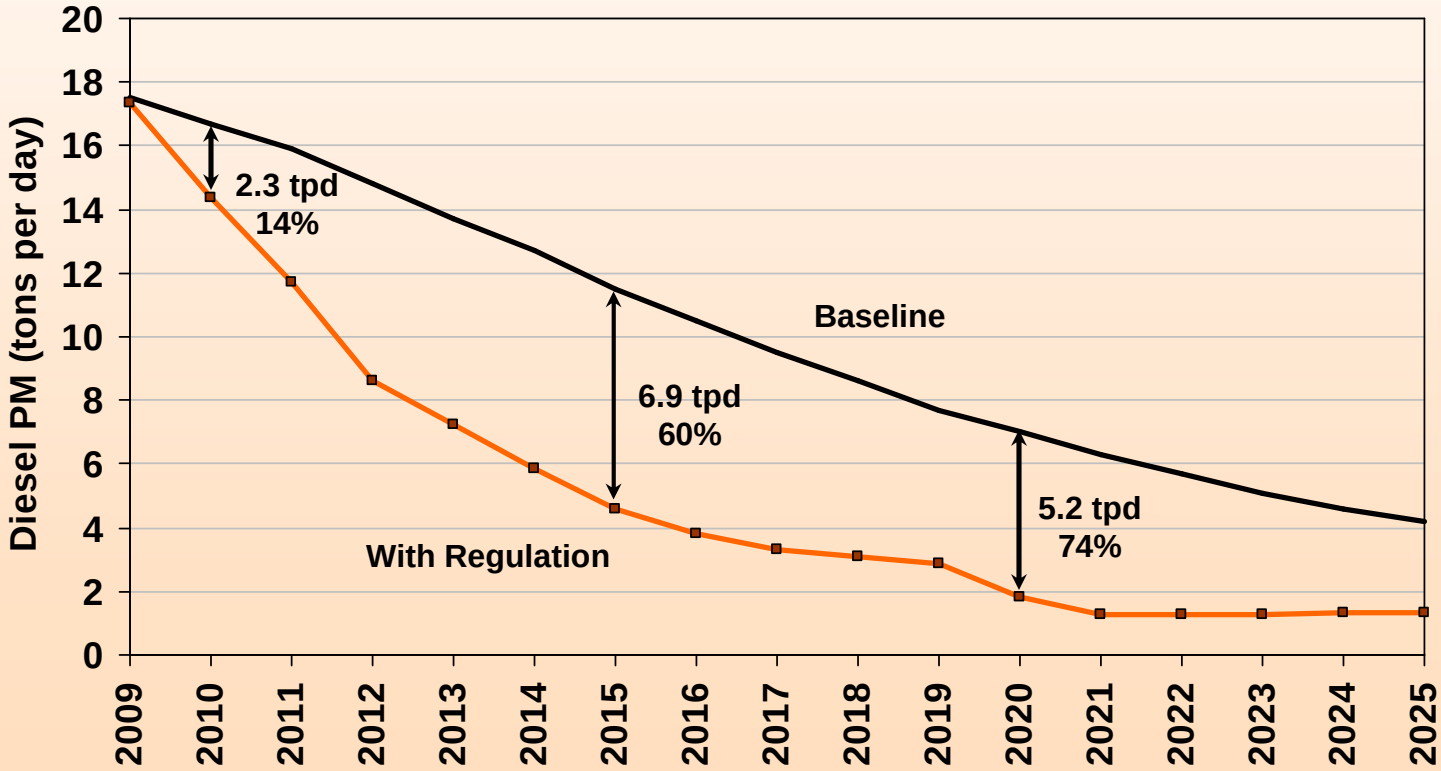
Myths About the Proposed Regulation

- Will devastate small businesses
- Requires immediate turnover of entire fleet
- Requires turnover to new vehicles only
- Cannot comply if PM retrofits not available
- Need all Tier 4 engines to comply

Benefits and Impacts

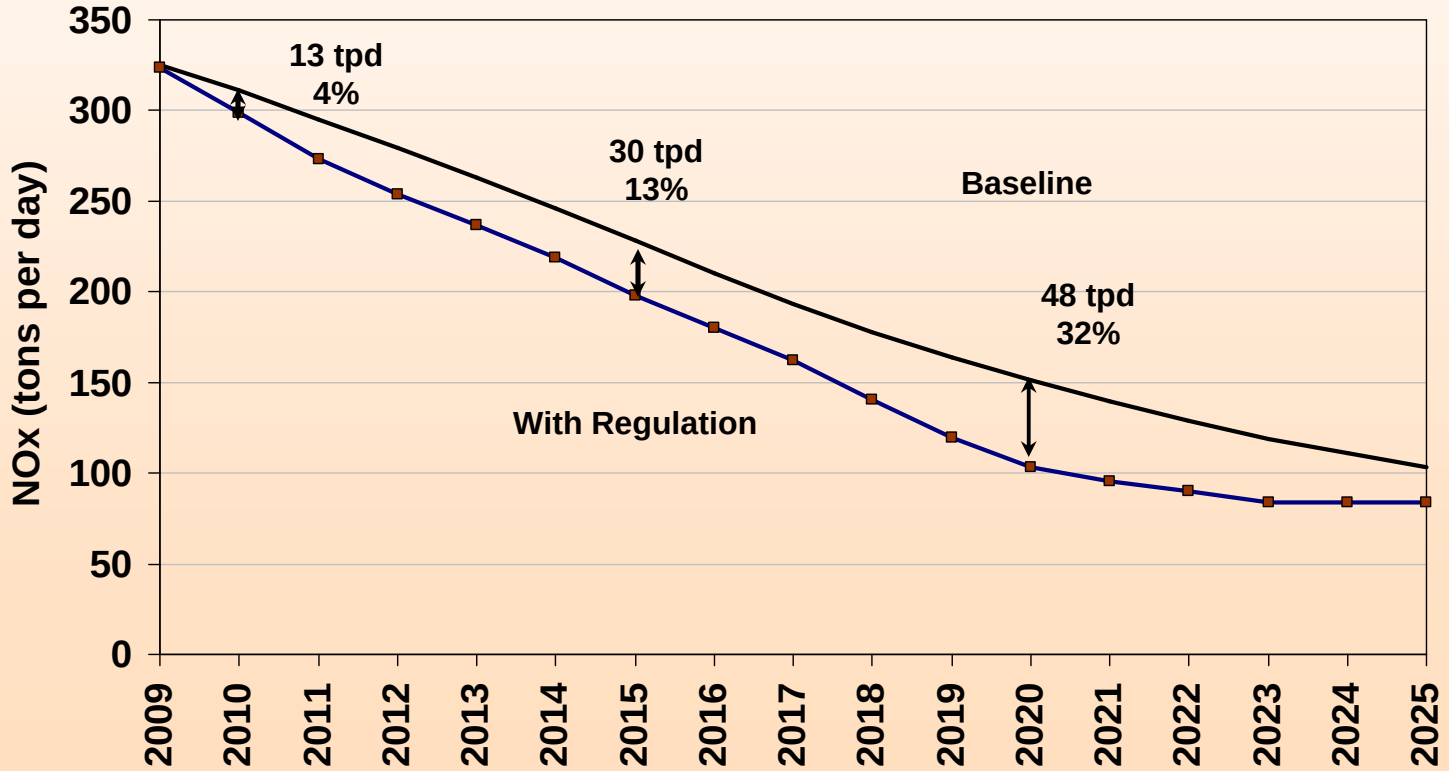
Diesel PM Emission Benefits

- Meets 2020 Diesel Risk Reduction Plan goals



NOx Emission Benefits

- Reductions needed to meet PM and ambient air quality standards



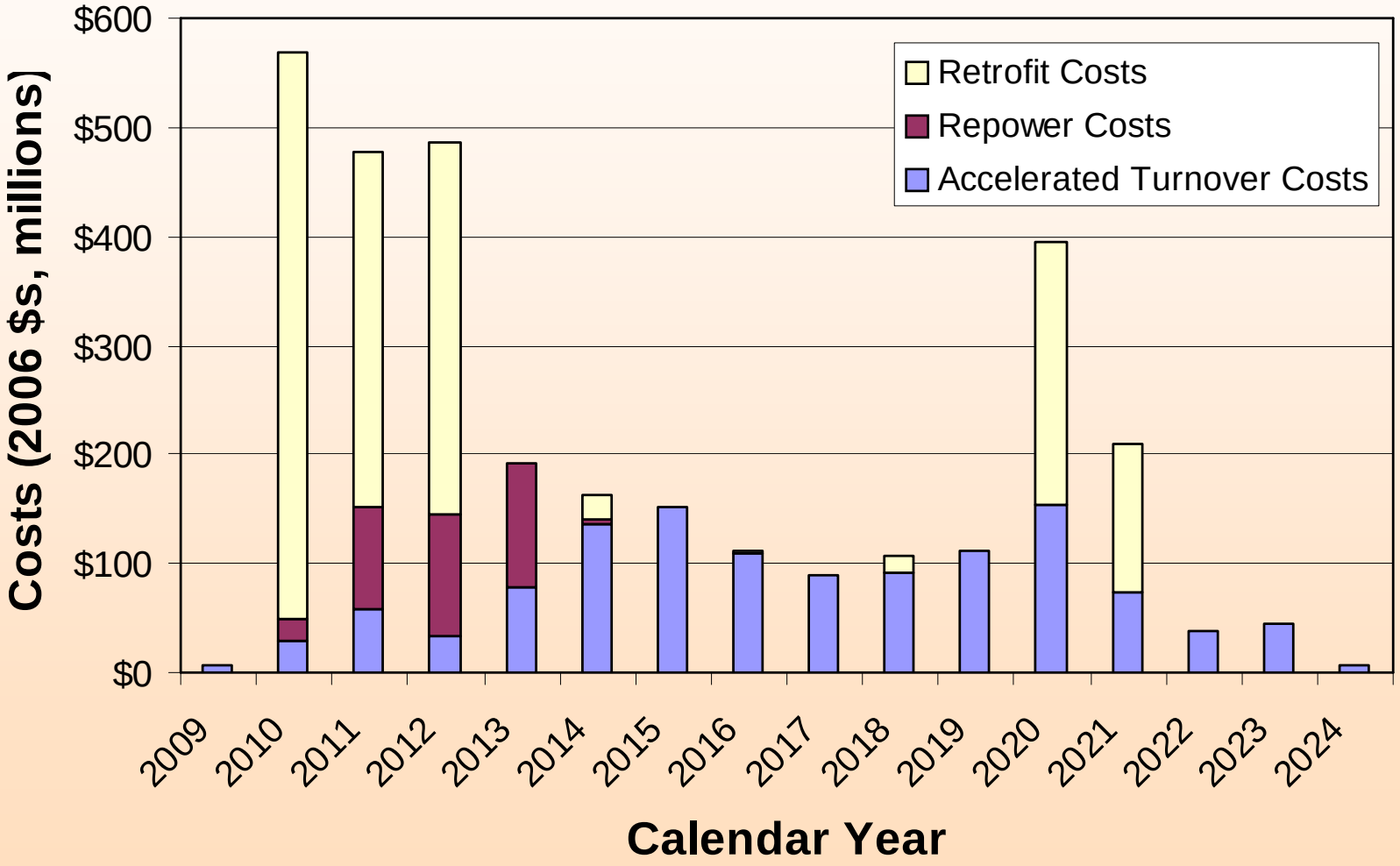
Cumulative Health Benefits

- **4,000 fewer premature deaths**
- 110,000 fewer cases of asthma and lower respiratory symptoms
- 680,000 work loss days
- 3,900,000 restricted activity days
- $18 - $26 billion in avoided health costs

Costs

- Total cost of $3.0 - $3.4 billion
  - Increase of 0.3% per year in statewide construction costs
- Cost-effectiveness
  - $37 - $43/lb PM
  - $2.1 - $2.5/lb NOx

Annual Costs



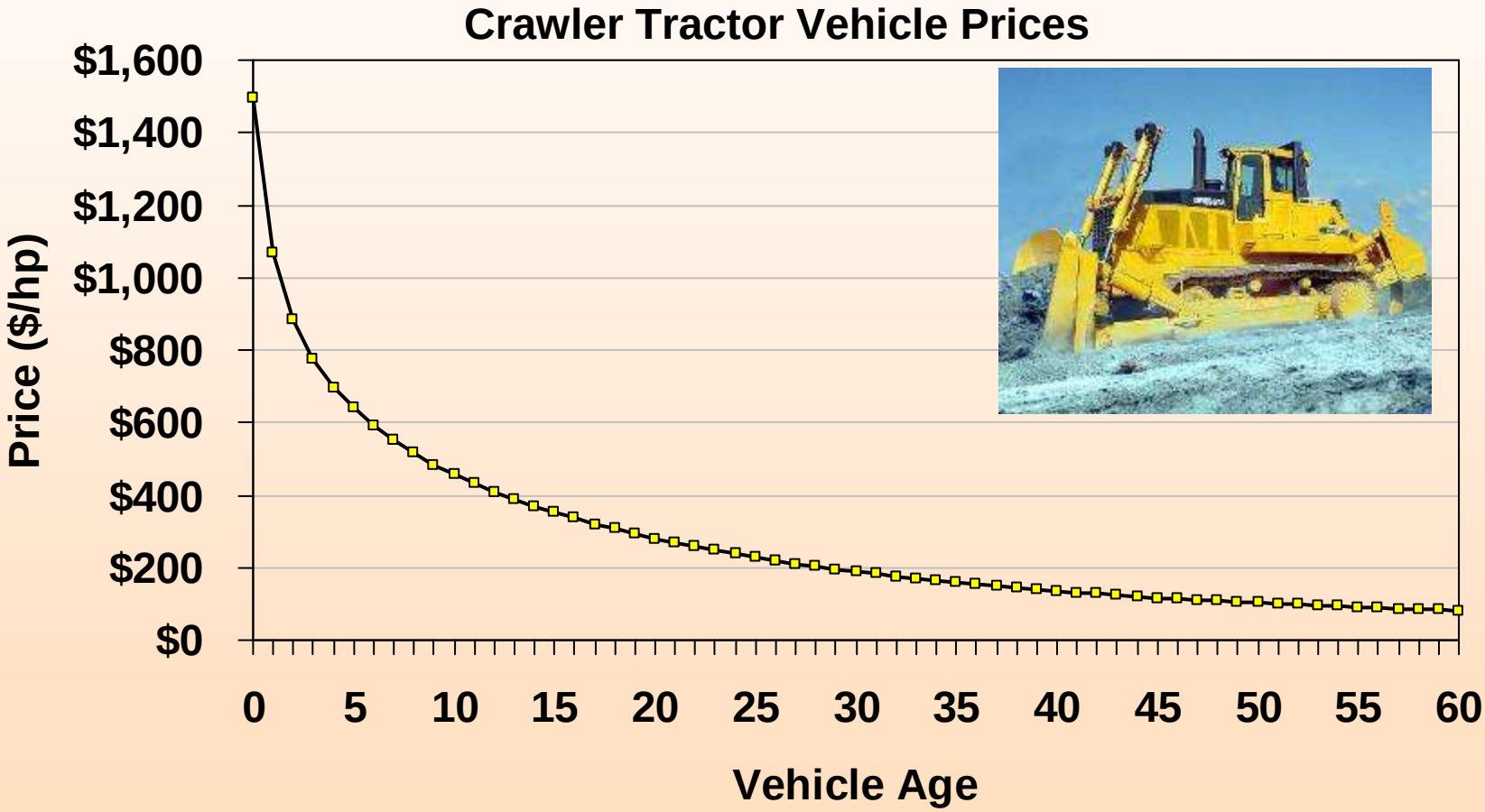
Costs Included

- Early vehicle turnover
- Repowers
- NOx and PM retrofits
- Increased costs for Tier 4 engines
- Reduced value of Tier 0 vehicles
- Fuel economy losses
- Filter regeneration and maintenance costs
- Reporting costs
- Excluded expected cost savings

Costs Analysis

- Modeled 200 actual fleets of varying age, engine size, and vehicle types
  - over 10,000 vehicles
- Determined fleet actions needed to comply
- Compared costs to normal turnover costs
- Scaled costs to statewide fleet

Example Vehicle Cost Inputs



Cost Inputs - Retrofits

- Based on high level PM controls
- Mix of technologies
- Costs from actual manufacturer quotes

Engine Size	Total Price
Less than 50 hp	$8,000
50 to 175 hp	$12,000
175 to 300 hp	$18,000
Greater than 300 hp	$30,000

Regulation's Economic Impact

- Expect most costs to be passed through
- Costs for 60-80% of fleets not expected to exceed 10% of profits
  - If no costs passed through to customers
  - Costs higher for older fleets with high horsepower, long-lived vehicles
- Some fleets will have to pass through costs to remain profitable
- Continued Moyer eligibility for small & medium fleets

Technological Feasibility

Catalyst based NOx and PM exhaust retrofit systems

Exhaust Retrofits

- Requirements already in place
  - New York City
  - LAX Community Benefits Agreement
  - Europe
  - US underground mining requirements
- Significant number of retrofits in service
  - Over 130,000 retrofits on heavy-duty vehicles
  - 35,000 DPFs retrofit on construction vehicles in Switzerland and Germany
- Croton Project in New York

Verification

- Ensures emission reductions and durability
- Provides end user warranty
  - 4-5 years and 2,600-4,200 operating hours

Level	PM Reduction	Typical Device
1	≥ 25%	Oxidation catalyst
2	≥ 50%	Flow-thru filter
3	≥ 85%	Particulate filter

DPF durability demonstration on concrete

Level 3 Diesel Particulate Filters Verified for Off-road Use

Product	Applicability
Cleaire Horizon	Most Tier 1 and higher off-road engines
Huss Umwelttechnik FS_MK	Most off-road diesel engines through 2007 model year
Engine Control System Combifilter	1996-2007 off-road engines

Off-Road Showcase Demonstration

- Joint program between ARB, SCAQMD, and MSRC
- $1 million in MSRC funding
- Program goals
  - Early emission reductions
  - Demonstrate off-road exhaust retrofits
  - Encourage retrofit verification
- Manufacturers will get off-road experience
- Fleets will get experience with retrofits

Repowers

- Replace existing engine with cleaner engine
- Many already funded through Carl Moyer incentive program
- Feasibility:
  - To Tier 1 straightforward
  - To Tier 2 usually possible
  - To Tier 3 more complex but often possible
  - To Tier 4 not likely
  - To On-Road certified engines (limited applicability)

Vehicle Availability

- Regulation allows for use of new or used vehicles
- Regulation adds at most 3% more turnover per year than normal
  - Equivalent to ~ 5,400 vehicles per year
- No significant increase in new vehicle demand
  - 329,000 new off-road vehicles sold in US each year
- No significant increase in used vehicle demand
  - Over 30,000 clean, used vehicles for sale on single day
- Fleet not penalized if new or used vehicles not available

Issues

Cost and Job Impacts

- <u>Industry Claims:</u>
  - Cost and job loss too high
  - Staff estimates are low
  - Industry estimates
    - $13 billion cost
    - 11,000 to 34,000 jobs lost

Cost and Job Impacts – Staff Response

- Industry cost estimates greatly inflated
  - Incorrectly assumed all fleets must do maximum turnover and retrofitting every year
  - Only modeled purchase of new (no used) vehicles
  - Neglected that vehicles normally replaced over time
  - Applied inflated PM retrofit costs to small vehicles
  - Arbitrarily applied retrofits only to engines less than 150 hp

Cost and Job Impacts – Staff Response Cont'd

- Industry job loss estimates inflated
  - Simplistic analysis performed
  - Attributed all regulatory costs to construction industry
    - Only 50% of affected fleets
  - ARB staff used peer-reviewed UC Berkeley model to estimate jobs lost throughout entire statewide economy

Ability to Pay

- Industry Claims:
  - Costs for some fleets too high and not bearable
  - Some fleets cannot pass on costs

PM filter on small engine skid steer

Ability to Pay - Staff Response

- Financial impact for most fleets manageable
- Some fleets will need to pass costs to customers
- All fleets operating in California subject to regulation
- Small fleets given until 2015 and exempted from mandatory turnover
- Medium fleets given until 2013

Bonding

- Industry Claim:
  - Regulation will reduce construction firms' ability to bond projects
    - Bonding is guarantee that contractor will complete contract, pay subcontractors
  - Regulation will cause firms to borrow money to comply and will reduce working capital, thereby reducing bonding capacity

Bonding – Staff Response

- Many do not use maximum bonding capacity
- Bonding capacity unaffected if costs passed through
- Bonding capacity also based on reputation, experience, credit history, etc.
- Most small contractors are small or medium fleets and thus get more time to comply

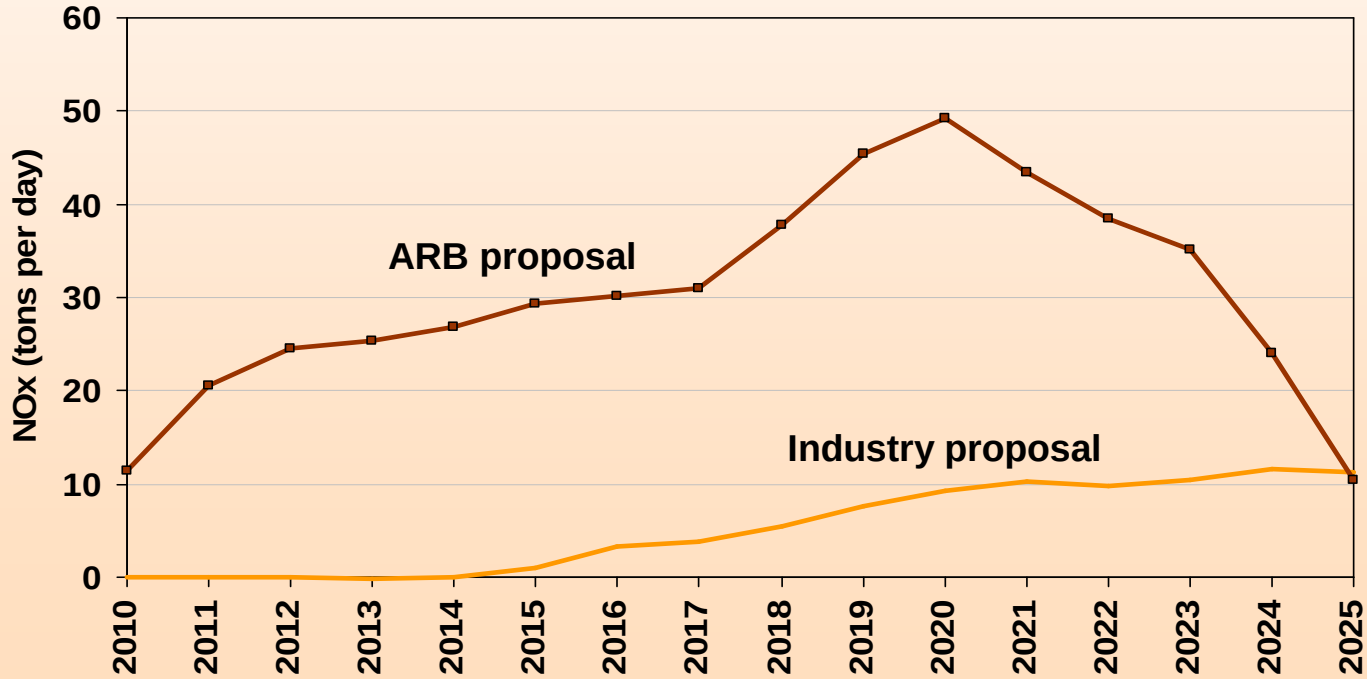
Timing

- Industry Alternative:
  - Delay compliance dates by 5 years

Level 2 PM device inside muffler

Timing – Staff Response

- Would get no benefit in 2014 (key year for SIP)
- Would achieve 80% less emissions reductions
- Would reduce cost by half



Regulation Too Weak

- Air District Proposal:
  - More early NOx reductions are feasible
    - 15% turnover for dirtiest fleets
    - More stringent NOx targets

Regulation Too Weak – Staff Response

- Proposal would achieve modest additional PM2.5 benefits
- Additional $1 billion in statewide cost
  - Mostly in first 3 years
- Adds disproportionate impact on older fleets

Is a Regional NOx Strategy More Appropriate?

- Concept:
  - Establish regional NOx requirements in South Coast and San Joaquin Valley
  - Two different approaches proposed:
    1) Keep statewide turnover in place, with additional turnover in these areas, or
    2) Don't require any turnover for fleets that never operate in these areas
  - Could work like captive attainment area provisions

Regional Strategies – Staff Response

- Advantages:
  - Target NOx reductions where most needed
  - Potential lower costs for some fleets
- Challenges:
  - Enforceability uncertain
  - Isolates South Coast and San Joaquin Valley
  - Additional complexity
  - Environmental Justice
  - Pollutant transport

Changes To Original Staff Report Proposal

- Tier 4 vehicle counts toward PM retrofit
  - OEM equipped with filter replacing a lower tier vehicle
- Replacement of diesel with gasoline vehicle
- Adjustment to hours of use provisions
- Clarify retrofit accounting provisions
- Clarify compliance credit provisions
- Other minor clarifications

Staff Recommendation

- Adopt with proposed minor changes